



Armed Forces College of Medicine AFCM





Intestinal Secretion

By

Mona Gamal El Din Al Anan



INTENDED LEARNING OBJECTIVES (ILO)



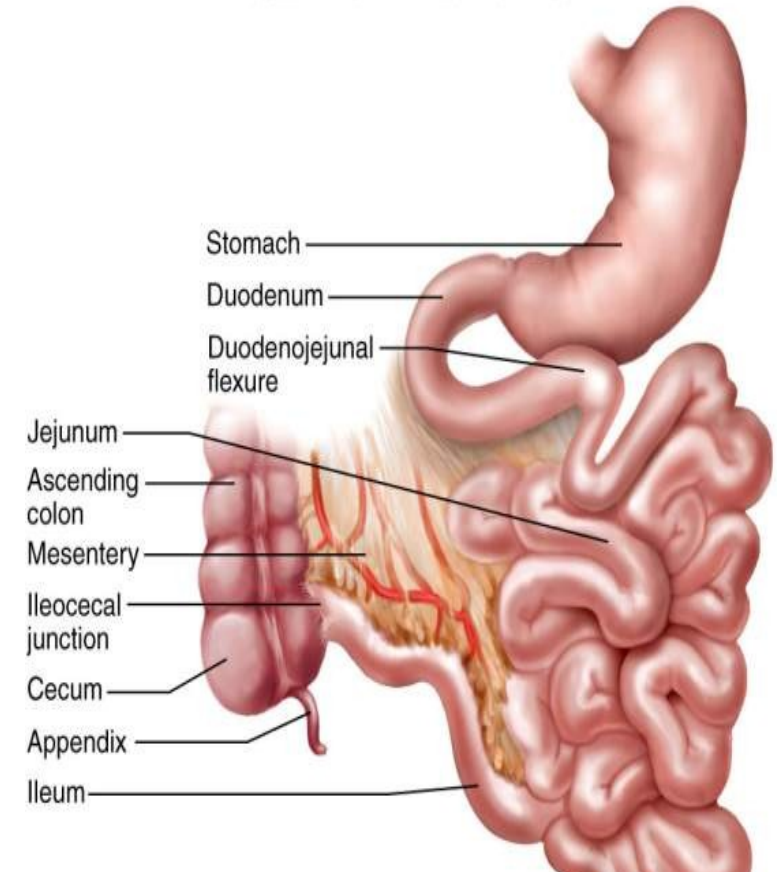
By the end of this lecture the student will be able to:

1. List composition of intestinal secretion
2. Explain its role in digestion and absorption
3. Compare between their functions
4. Apply knowledge to solve clinical problem

Small Intestine



- **Proximal part** □ Duodenum “Mixing bowl”
 - * Receive □ Chyme from stomach + digestive secretions from “pancreas & liver”
 - * Neutralize ??? “acids before they can damage the absorptive surfaces of the small intestine”
- **Middle part** □ Jejunum
 - Location of most - Chemical digestion
 - Nutrient absorption
- **Distal part** □ Ileum ??



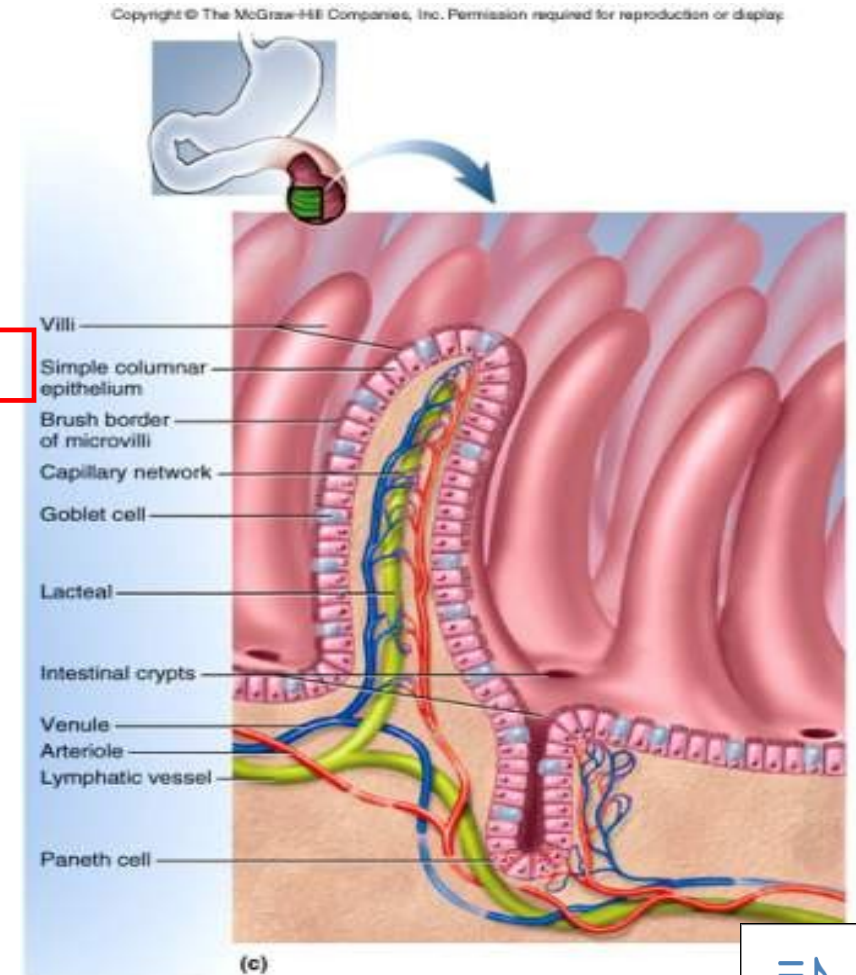
• ***Most digestion and absorption happens in small intestine (SI)***



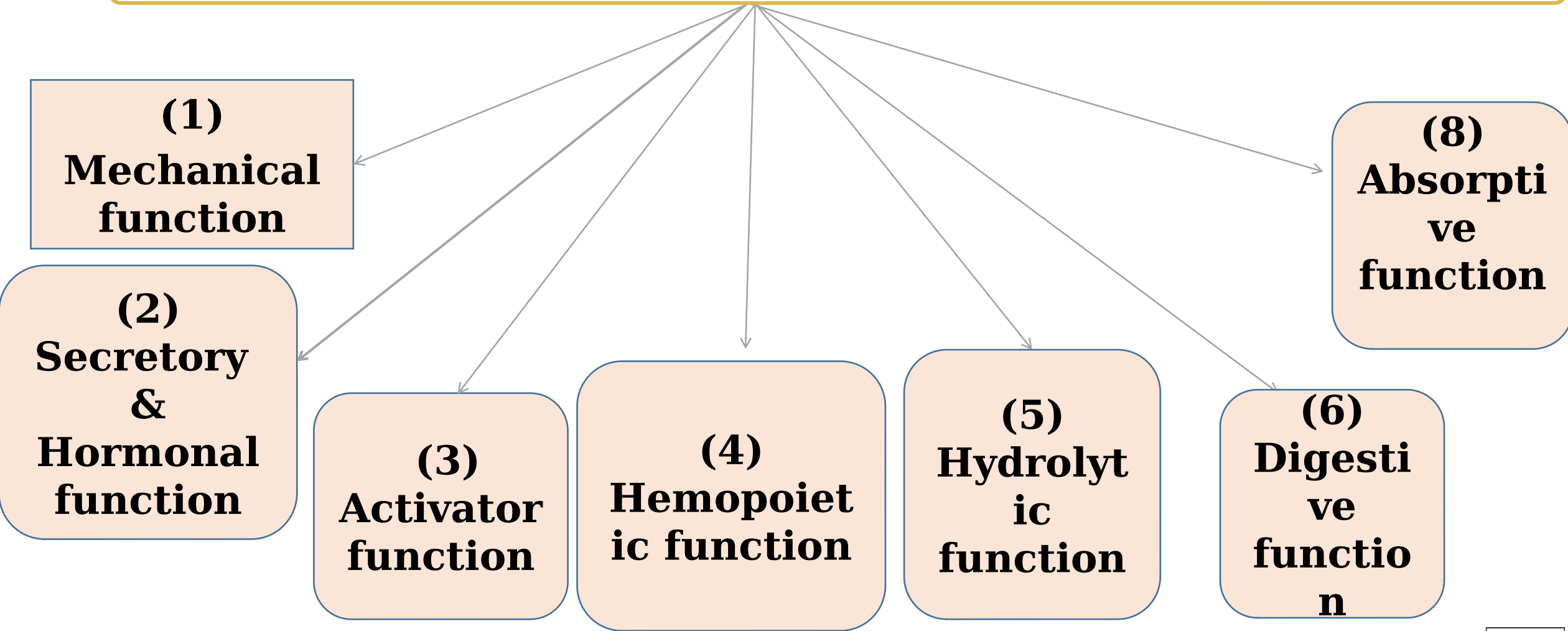
Small Intestine



- Villi “blood vessels and lymphatic” □ Nutrient absorption
- Microvilli, brush border □ Enzymes □ Final stages of digestion
- Enterocytes □ Enzymes
- SI cells □ Different secretions



Functions of small intestine



Succus Entericus



(1) Properties of
succus
entericus

*"secretions from the small
intestine"*

(2) Composition
of succus
entericus

(3) Functions
of
succus
entericus

Properties of succus entericus

**Volume $\approx$
1800
mL/day**

**Reaction
Alkaline**

pH $\approx$ 8.3



Composition of succus entericus



Water 99.5%

Solids 0.5%

Organic substances

Inorganic substances

Enzymes

Other organic substances

Proteolytic enzymes
"Peptidases"
1. Amino peptidase
2. Dipeptidase
3. Tripeptidase

Amylolytic enzymes
1. Sucrase
2. Maltase
3. Lactase
4. Dextrinase
5. Trehalase

1. Mucus
2. Interinsic factor
3. Defensins

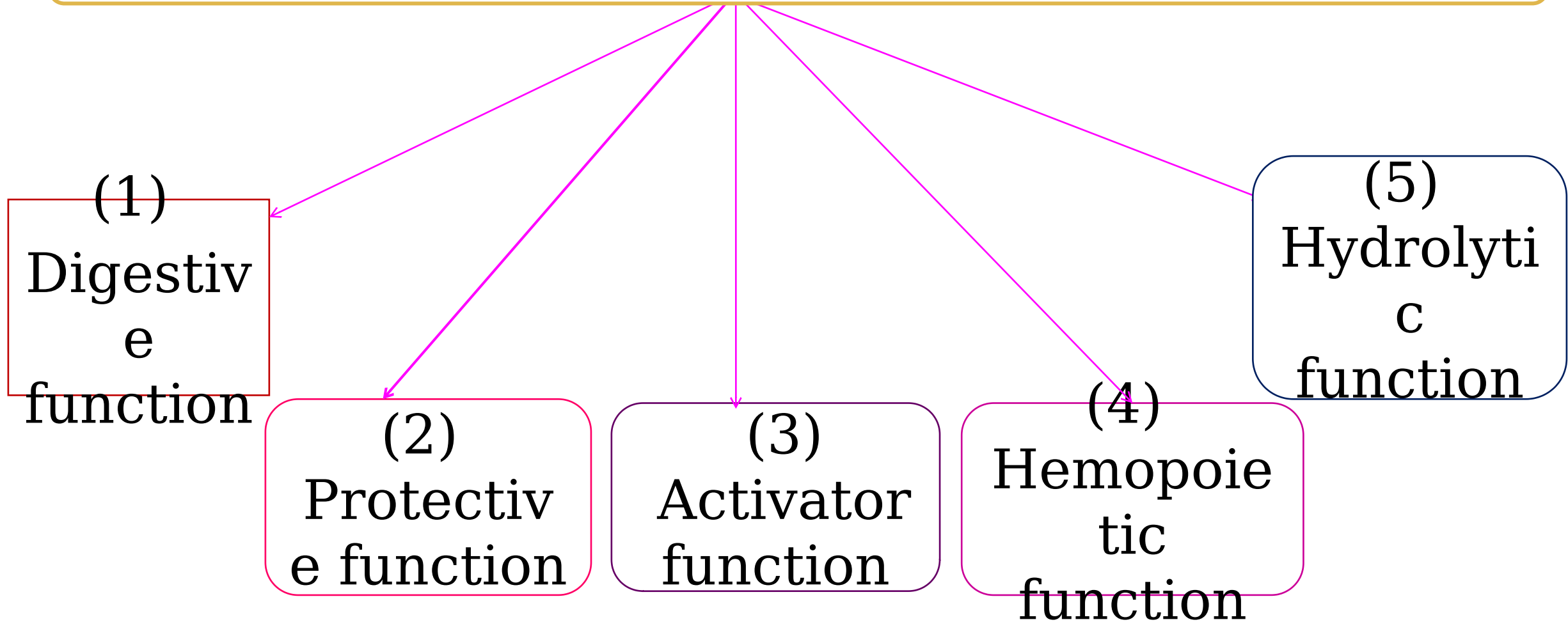
1. Sodium
2. calcium
3. Potassium
4. Bicarbonate
5. Chloride
6. Phosphate
7. Sulfate

Enterokinase

Lipolytic enzymes "Lipase"



Functions of succus entericus



Regulation of secretion of succus entericus

Regulated by both Nervous and Hormonal mechanisms



Nervous Regulation

Parasympathetic stim. $\square$ V.D
and increases secretion

Sympathetic stim. $\square$ V.C
and decreases secretion

Role of Symp. & parasym. in regulation in physiological conditions is uncertain

The local nervous reflexes play an important role in increasing the secretion of intestinal juice

Chyme $\square$ S.I. $\square$ (+) the mucosa $\square$ local nervous reflexes $\square$ (+) intestinal glands

(+) = stimulate



Regulation of secretion of succus entericus

Regulated by both nervous and hormonal mechanisms



HORMONAL REGULATION

Chyme → Small intestine → (+)
Intestinal mucosa → Enterocrinin,
Secretin & cholecystokinin → (+)
intestinal glands → Secretion of
succus entericus



Some important hormones in GIT



<u>HORMONE</u>	<u>LOCALIZATION</u>	<u>MAIN PHYSIOLOGIC ACTIONS</u>
		• Inhibits gastric emptying • Trophic effects on the

<https://i.ytimg.com/vi/5cW9AnqgJDA/maxresdefault.jpg>



Digestive enzymes of succus entericus



	Enzyme	Substrate	End products
Intestinal mucosa	Enteropeptidase “ ”	trypsinogen	trypsin
	Peptidases “....,&...”	Peptides	Amino acids
	Sucrase	Sucrose	Fructose and glucose
	Maltase	Maltose and malotriose	Glucose
	Lactase	Lactose	Galactose and Glucose
	Dextrinase	Dextrin, maltose and maltriose	Glucose
	Trehalase	Trehalose	Glucose
	Intestinal lipase	Triglycerides	Fatty acids
	Nuclease and related enzymes	Nucleic acids	Pentoses and purine & pyrimidine bases
Cytoplasm of mucosal cells	Various peptidases . . .	Di-, tri-, and tetrapeptides	Amino acids



Digestive function of succus entericus



“proteolytic enzymes” peptidases

Amino
peptidase

Dipeptidase

Tripeptidas
e

Endopeptidase “Cleave between residues in mid portion of peptide”

Amino peptidase “Cleave amino terminal amino acid from peptide”

Carboxypeptidase “Cleave carboxyl terminal amino acid from peptide”



Digestive function of succus entericus



“Amylolytic enzymes”

1-
Sucrase

2- Maltase

3-
Lactase

4-
Dextrinase

5-
Trehalase

They convert..... into



Digestive function of succus entericus

“Lipolytic enzymes”



Intestinal
lipase

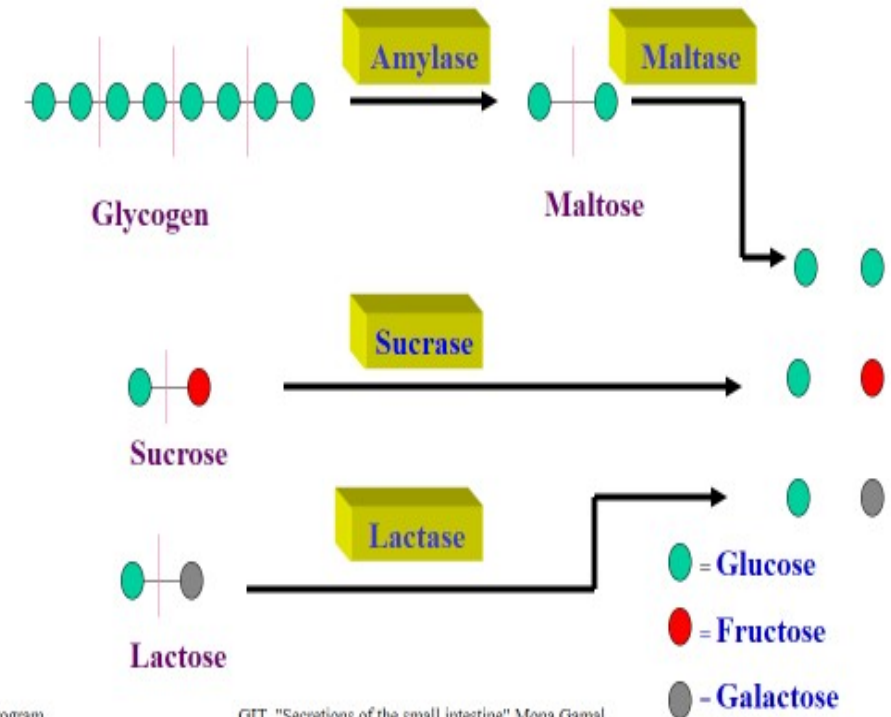
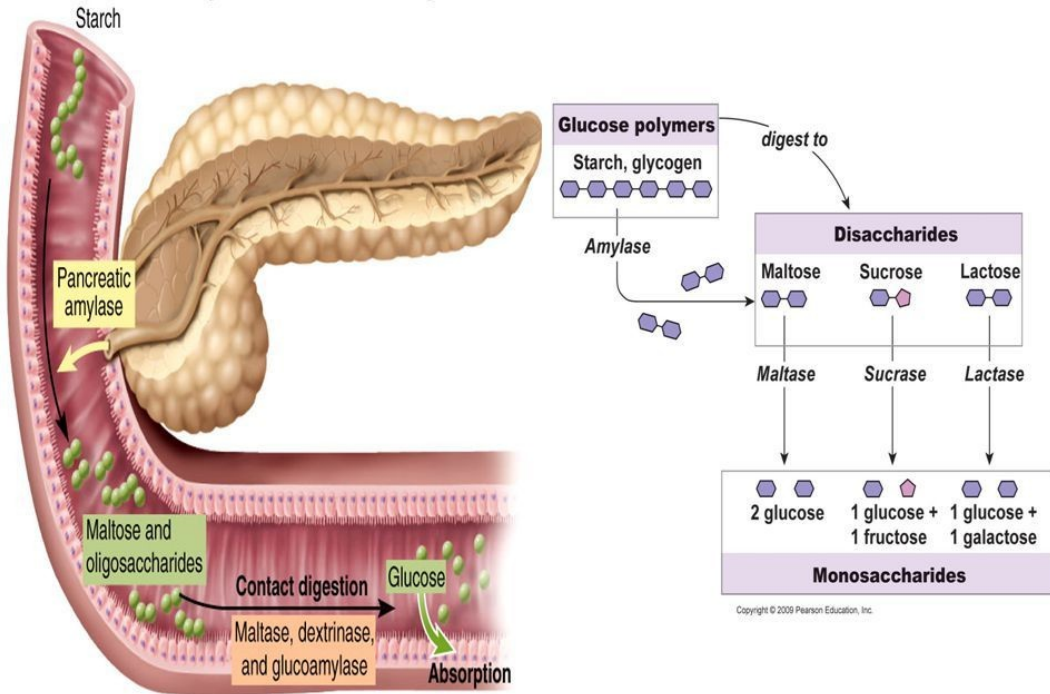
Act on triglycerides → Fatty acids



Carbohydrate Digestion - Small Intestine



Carbohydrate Digestion - Small Intestine



New Five Year Program

GIT "Secretions of the small intestine" Mona Gamal

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<https://i.pinimg.com/originals/a7/06/b2/a706b28d549c3aa4aa701fafbfcf161f.jpg>

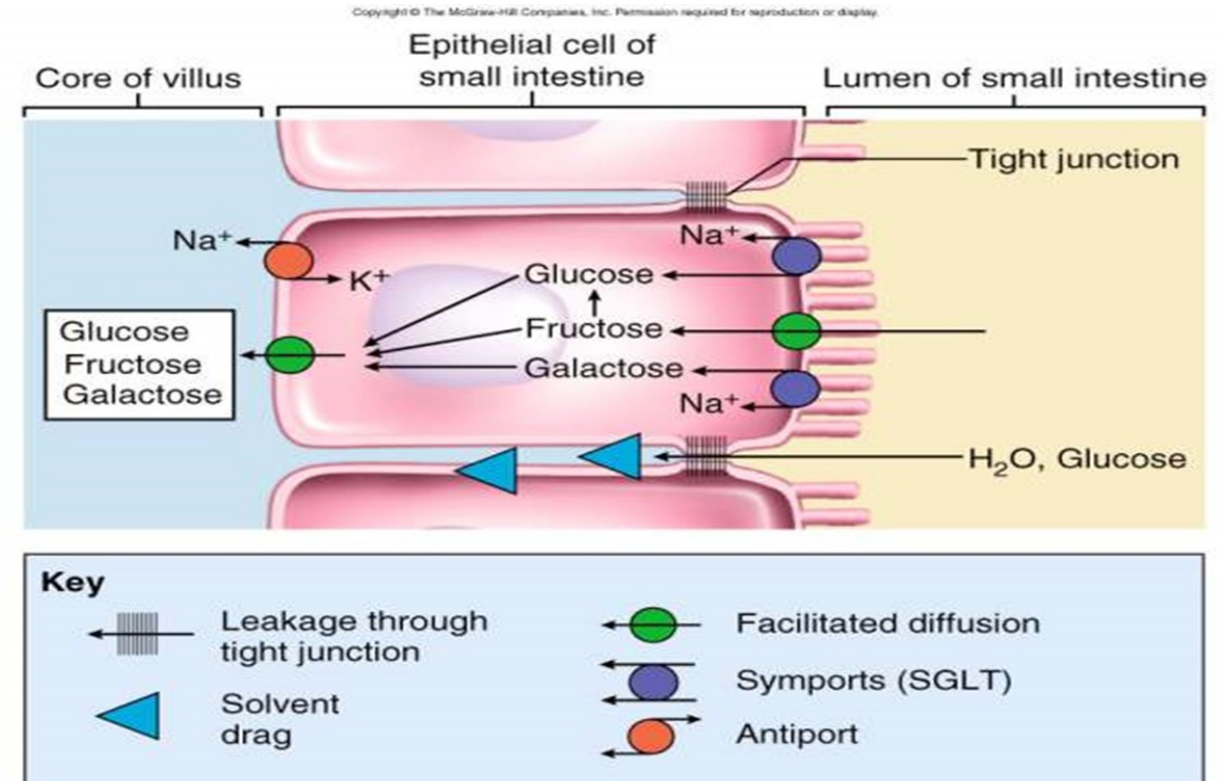
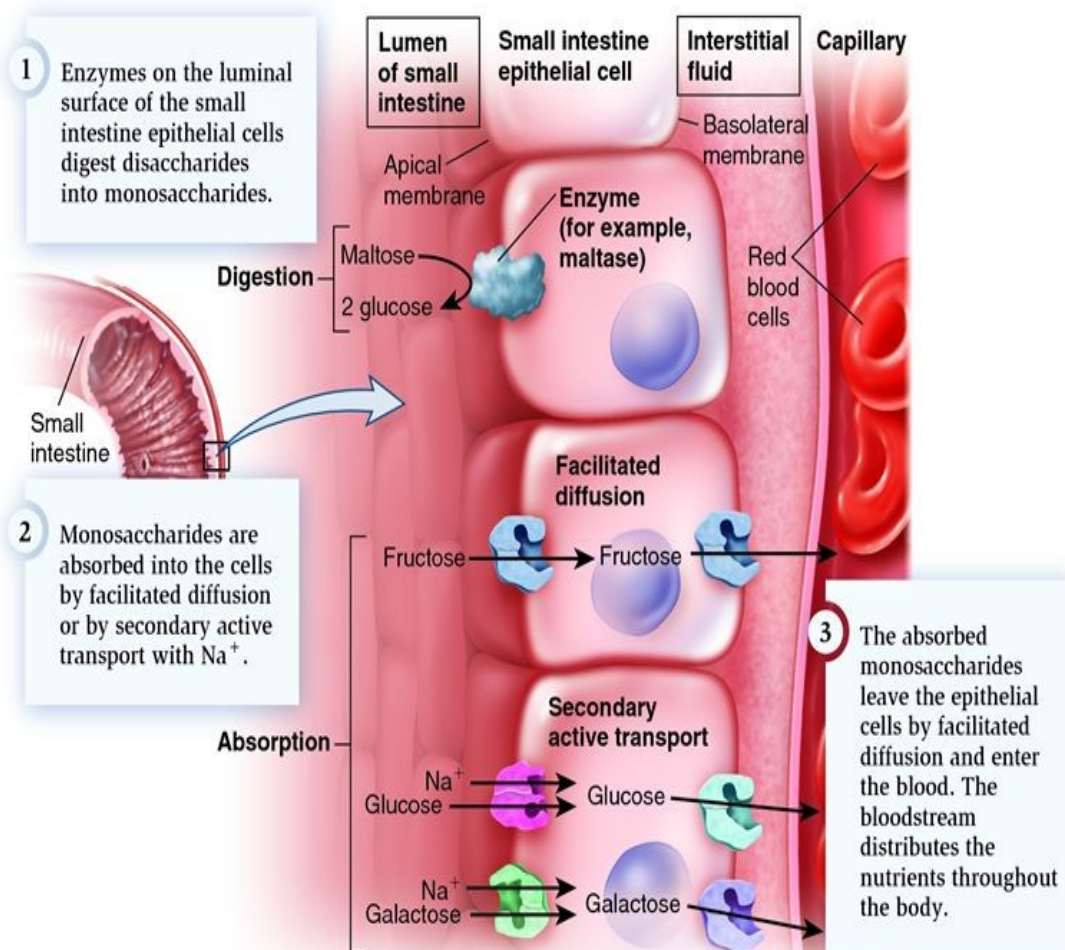
New Five Year Program

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Carbohydrate Absorption



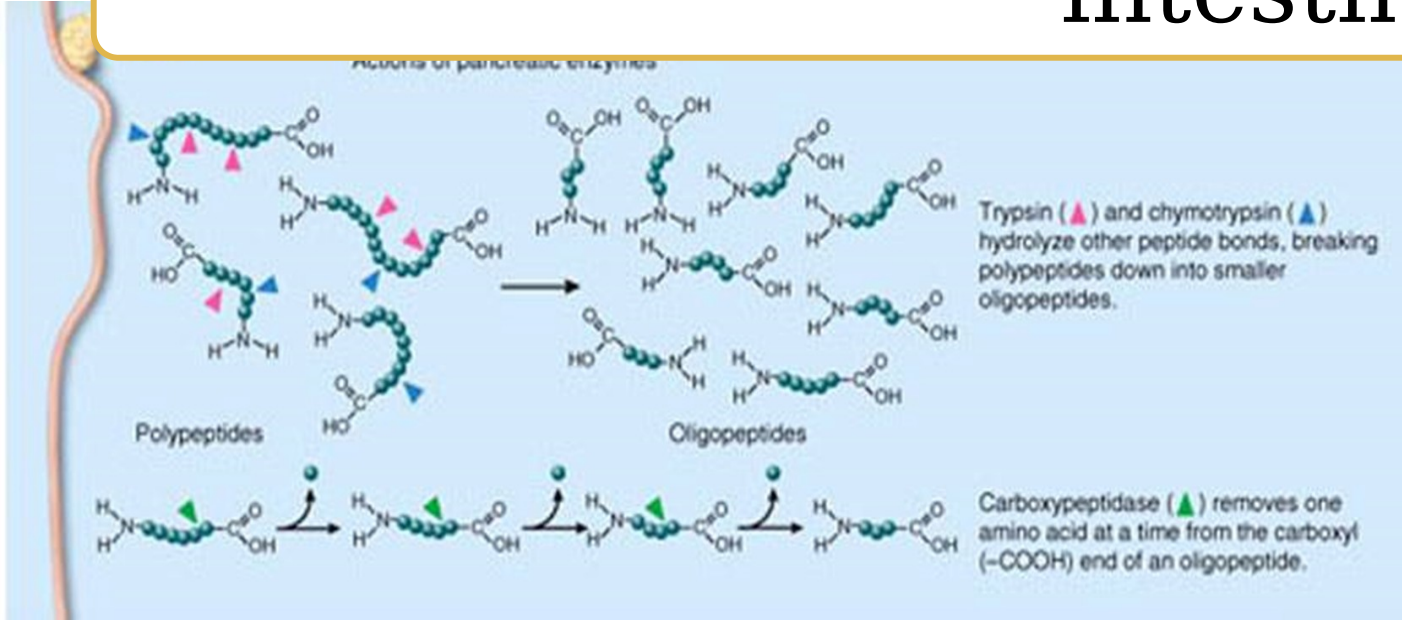
❖ Glucose and Galactose -- "SGLT"

❖ Fructose -- Facilitated diffusion

❖ Fructose converted to glucose



Protein Digestion and Absorption in small intestine

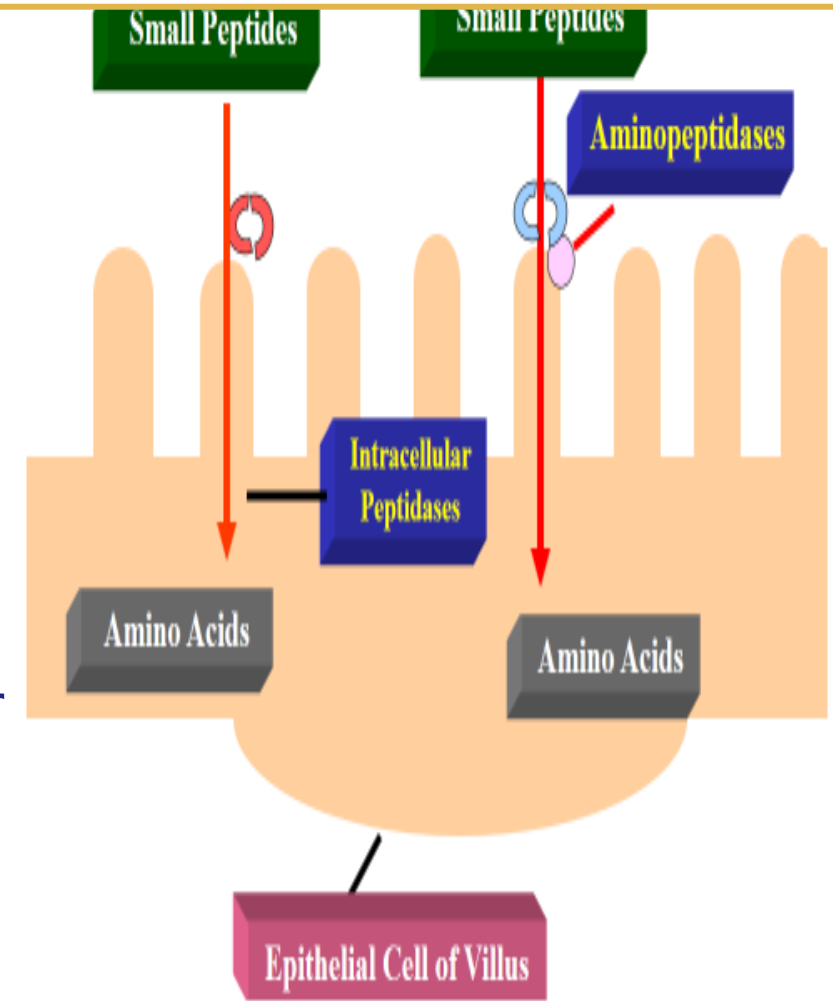


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- Pancreatic enzymes → polypeptides → shorter oligopeptides
- Intestinal enzymes finish task → amino acids
- “absorbed → intestinal epithelial cells”

New Five Year Program

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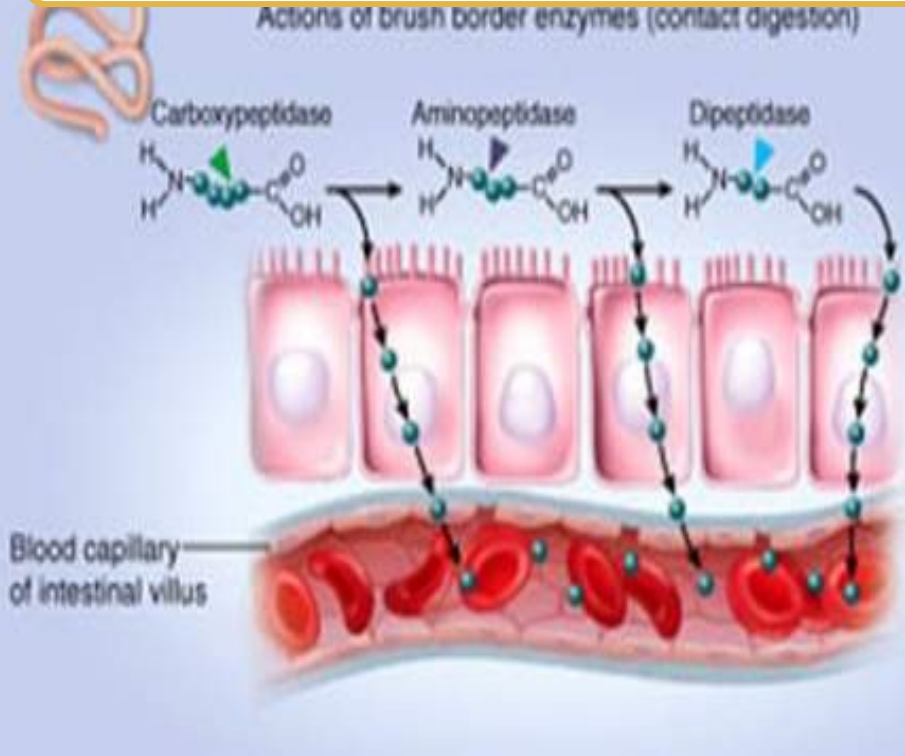


Protein Digestion and Absorption in small intestine



Small peptides

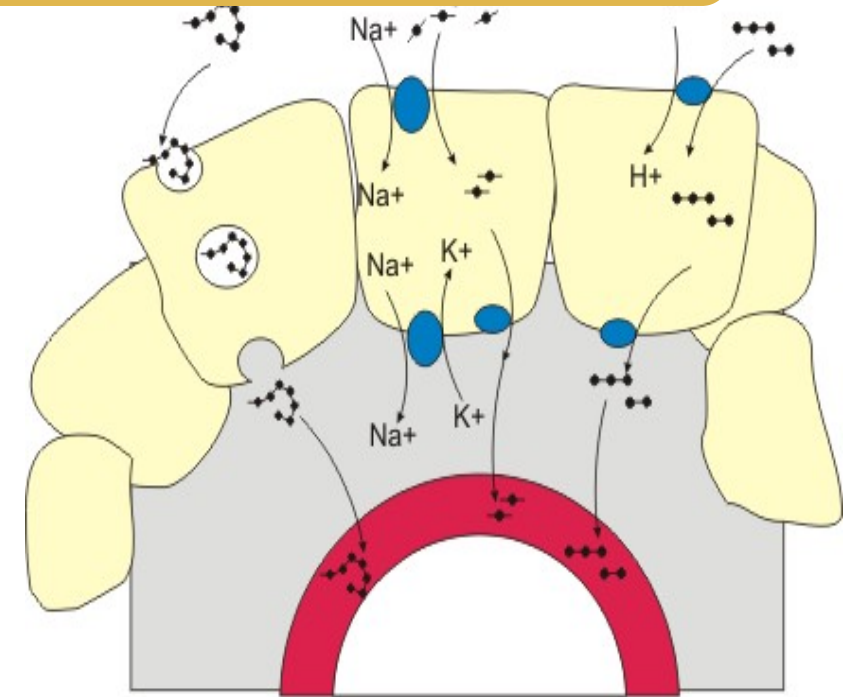
Actions of brush border enzymes (contact digestion)



Carboxypeptidase (▲) of the brush border continues to remove amino acids from the carboxyl ($-\text{COOH}$) end.

Aminopeptidase (▲) of the brush border removes one amino acid at a time from the amino ($-\text{NH}_2$) end.

Dipeptidase (▲) splits dipeptides (●●) into separate amino acids (●).



Frank Boumphrey M.D. 2009

<https://qph.fs.quoracdn.net/main-qimg-96df82f6bc506ac68e692578a2a8e6bc.webp>

https://upload.wikimedia.org/wikipedia/commons/0/0a/Absorb_pept.png

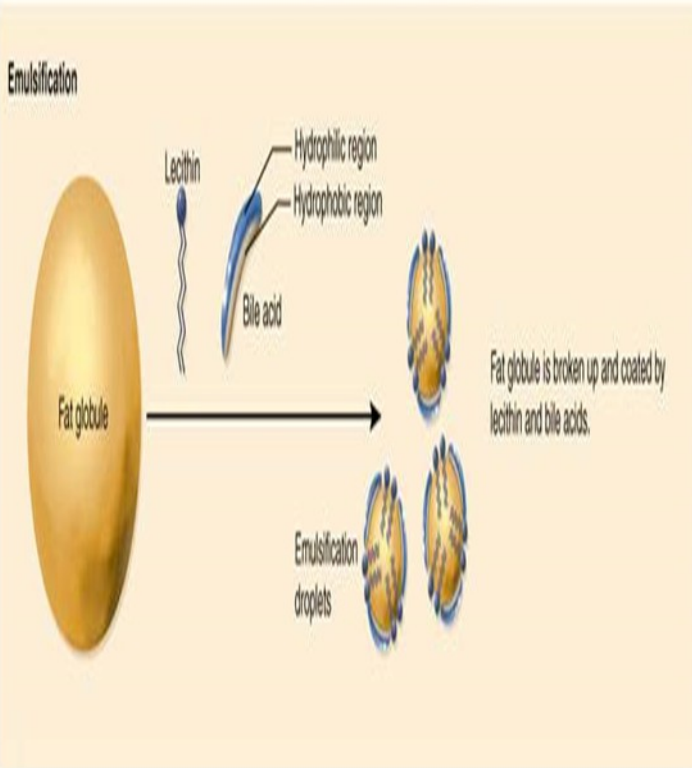
- Amino acids are absorbed into intestinal epithelial cells
 - Amino acid cotransporters
 - Facilitated diffusion □ Blood stream
- Proteins can be absorbed by pinocytosis in infants



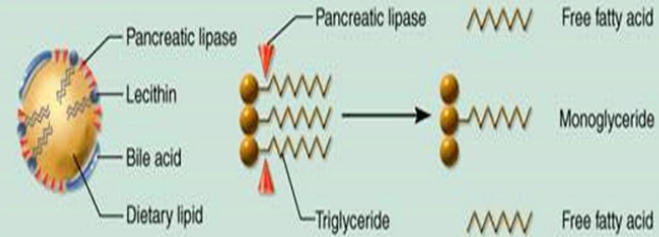
Fat Digestion and Absorption in small intestine



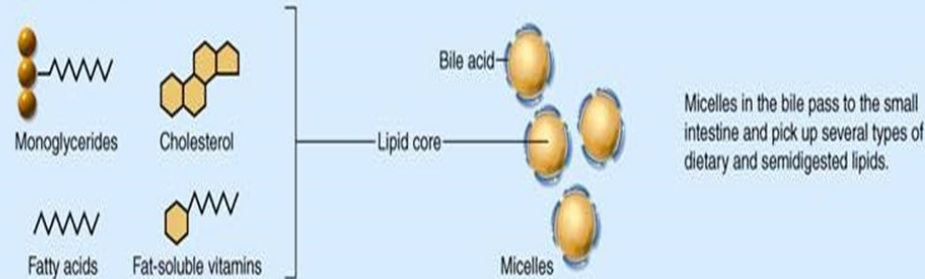
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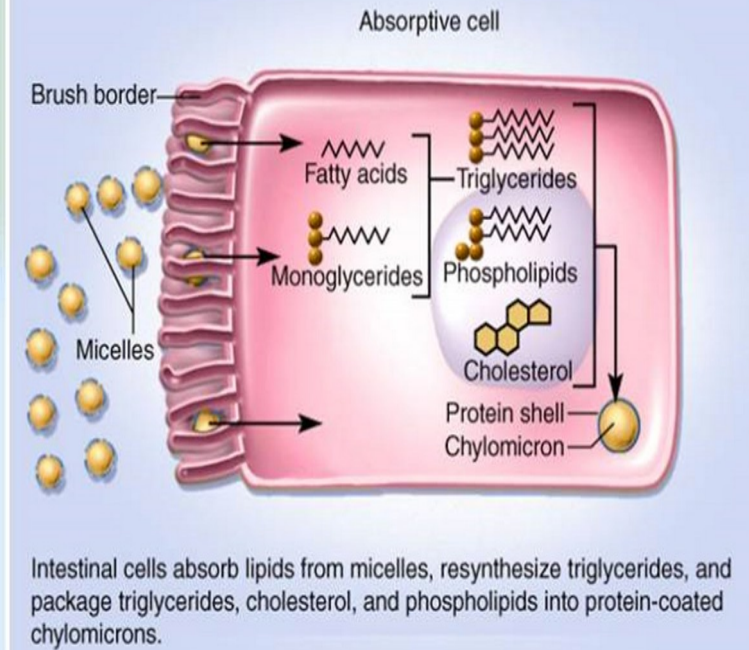
Fat hydrolysis



Lipid uptake by micelles



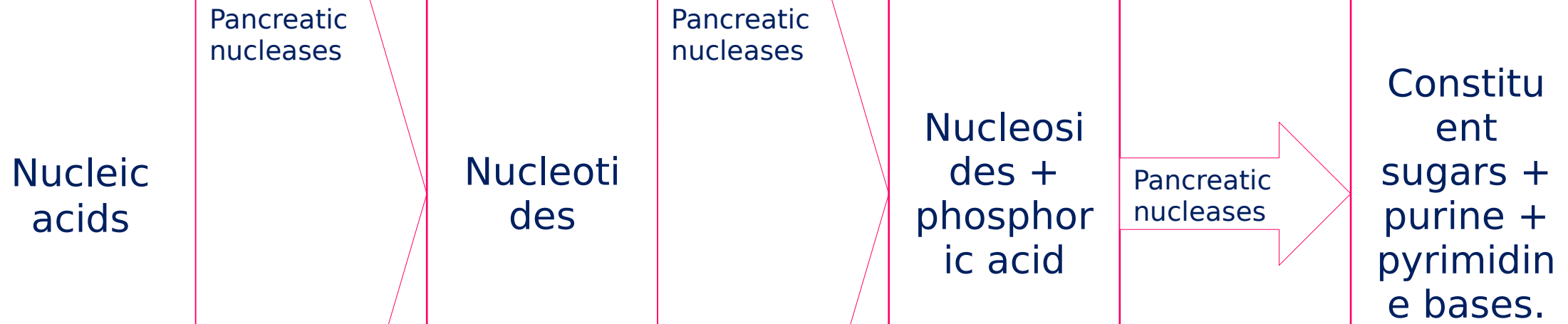
Chylomicron formation



Chylomicron.....???



Nucleic Acids Digestion and Absorption



The bases are absorbed by active transport

Absorptive Function of Small Intestinal Mucosa



presence of

Large Surface Area

Specialized Transport Mechanisms

High Cell Division of Small Intestine Epithelial Cells

Rapid replacement of Epithelial lining

Enzymes
Surface Area

Improve Digestion

Improve Absorption



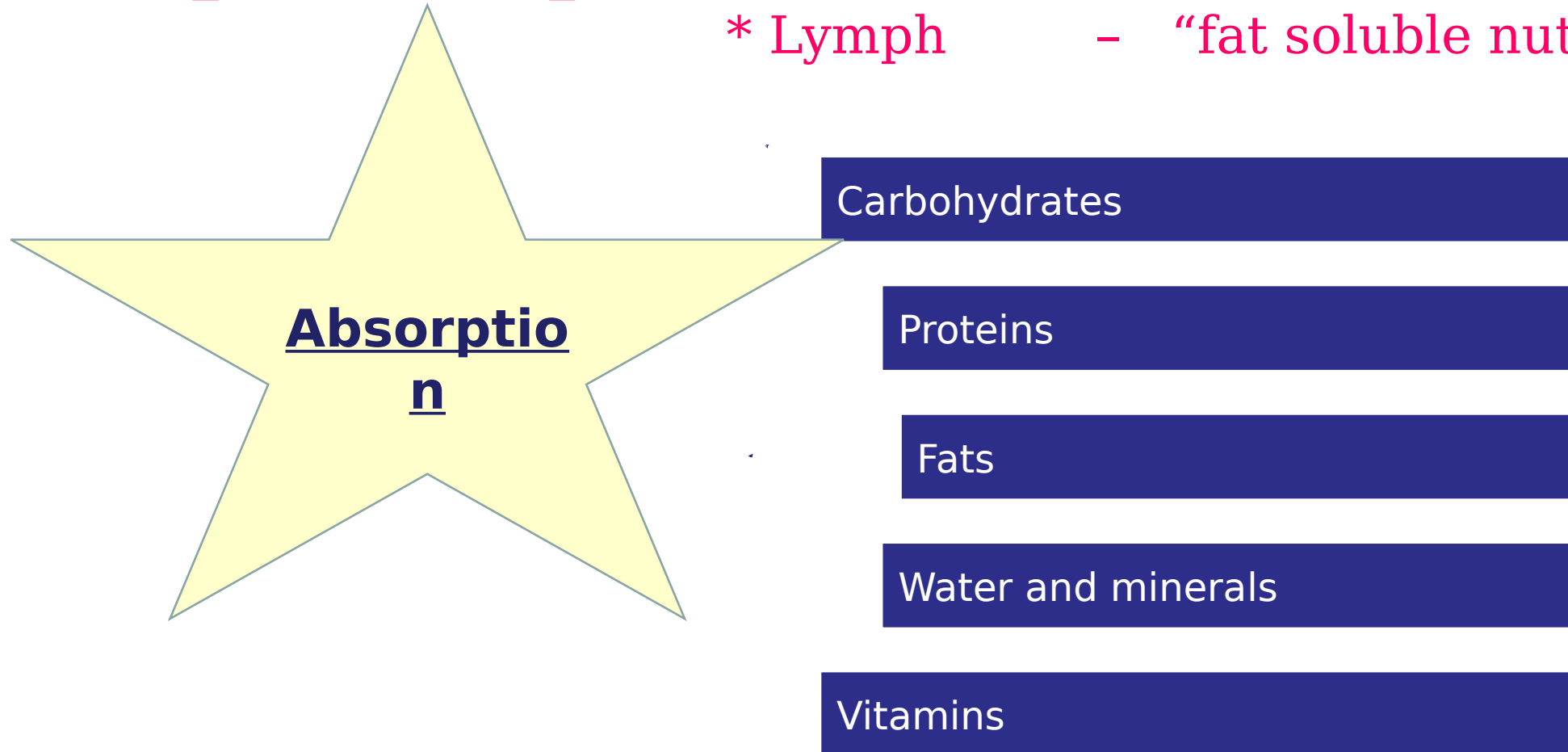
Absorptive function of small intestine



Nutrient □ absorbed □

* Blood
* Lymph

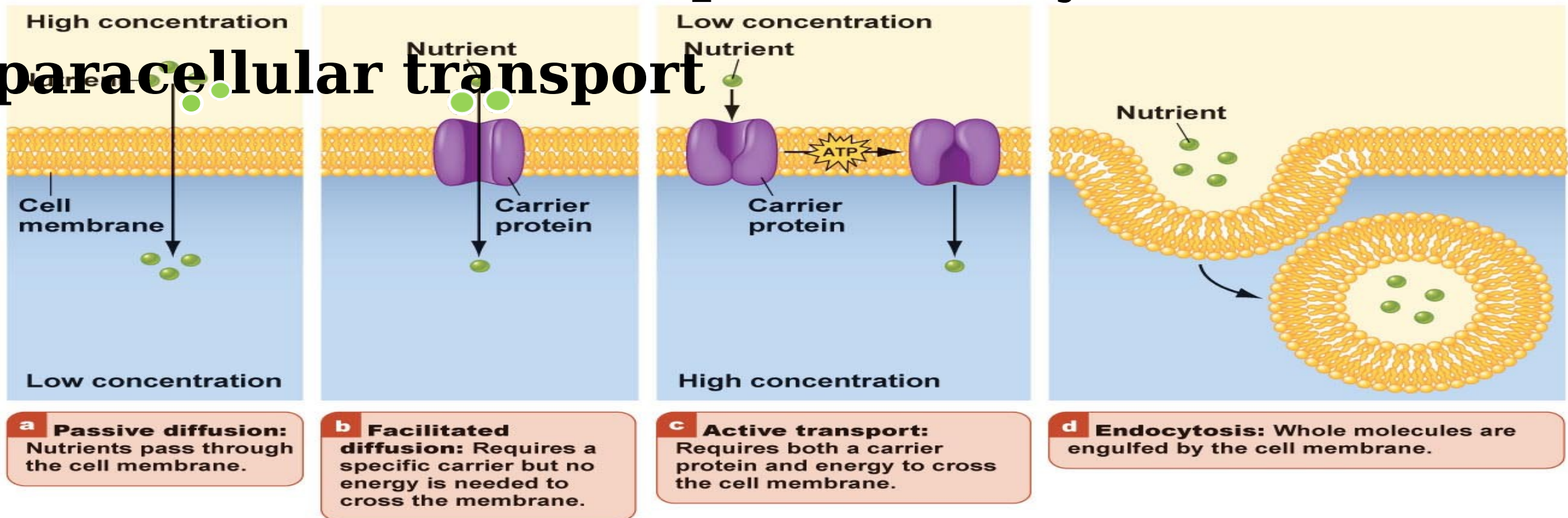
– “water soluble nutrients”
– “fat soluble nutrients”



Nutrient absorption in Small intestine



Absorption occurs by **simple diffusion, facilitated diffusion, active transport, endocytosis,.....and paracellular transport**



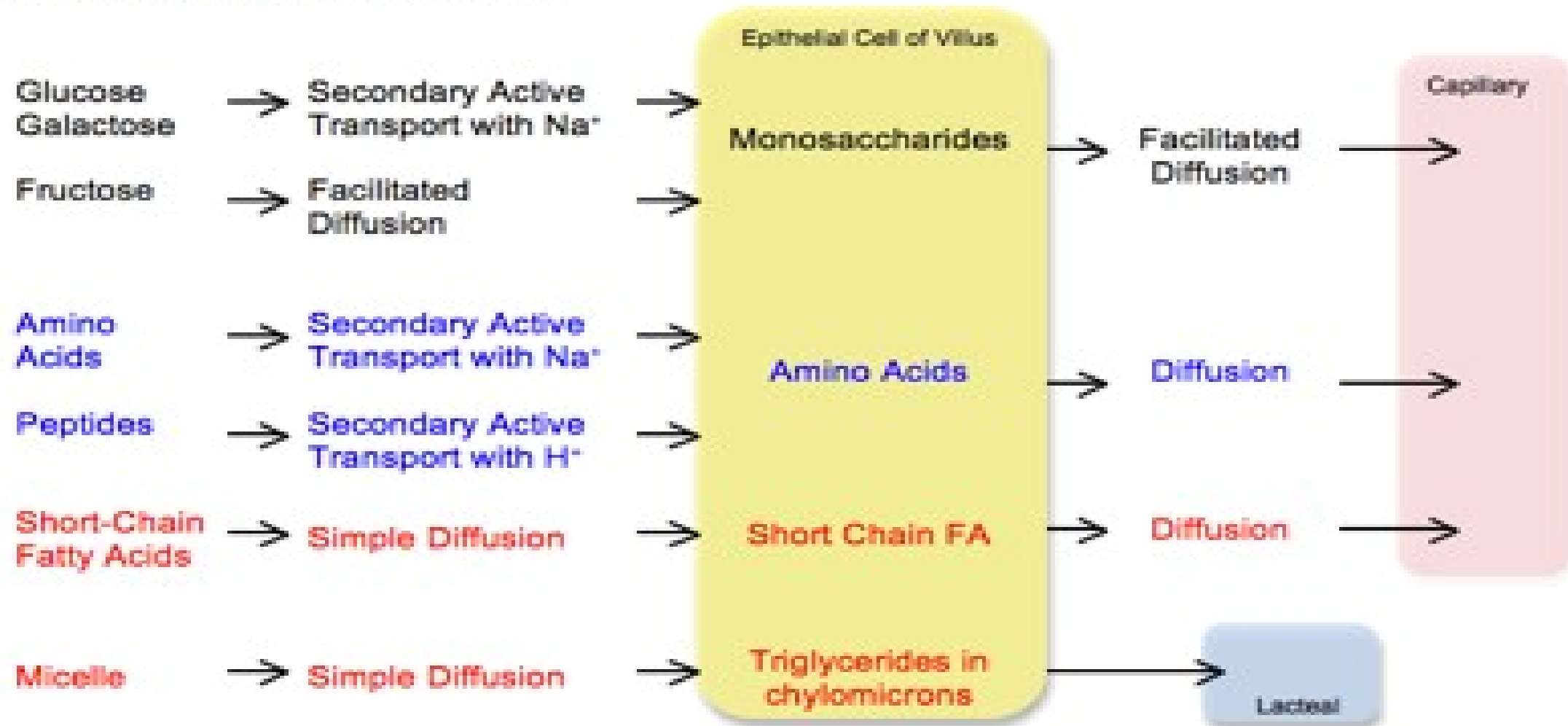
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Nutrient absorption in Small intestine



Absorption in the Small Intestine



http://www.sharinginhealth.ca/multimedia/images/small_intestine_absorption_Kathryn_Dorman.jpg



Absorption in the small intestine



Water and Minerals

Water “osmotic pressure”

Minerals “All along small intestine”

Sodium “Na⁺” : actively &...??.... “sodium cotransport”

Chloride ion “cl⁻” : actively “In ileum”

Calcium “Ca⁺⁺” : actively “mostly in upper part of small intestine”

Magnesium & Calcium facilitated by protein

Potassium K⁺ Mostly by simple diffusion & Little by active.....

Iron “Almost in the duodenum” ?? DMT1



Absorption of Vitamins in small intestine



Vitamins
“unchanged”

* Most “in upper
part of small
intestine”

Vitamin B12 “in
ileum”

Vitamin B 12 &
folate absorption
are Na^+ -
independent

The remaining
water-soluble
vitamins need
carriers

“ Na^+

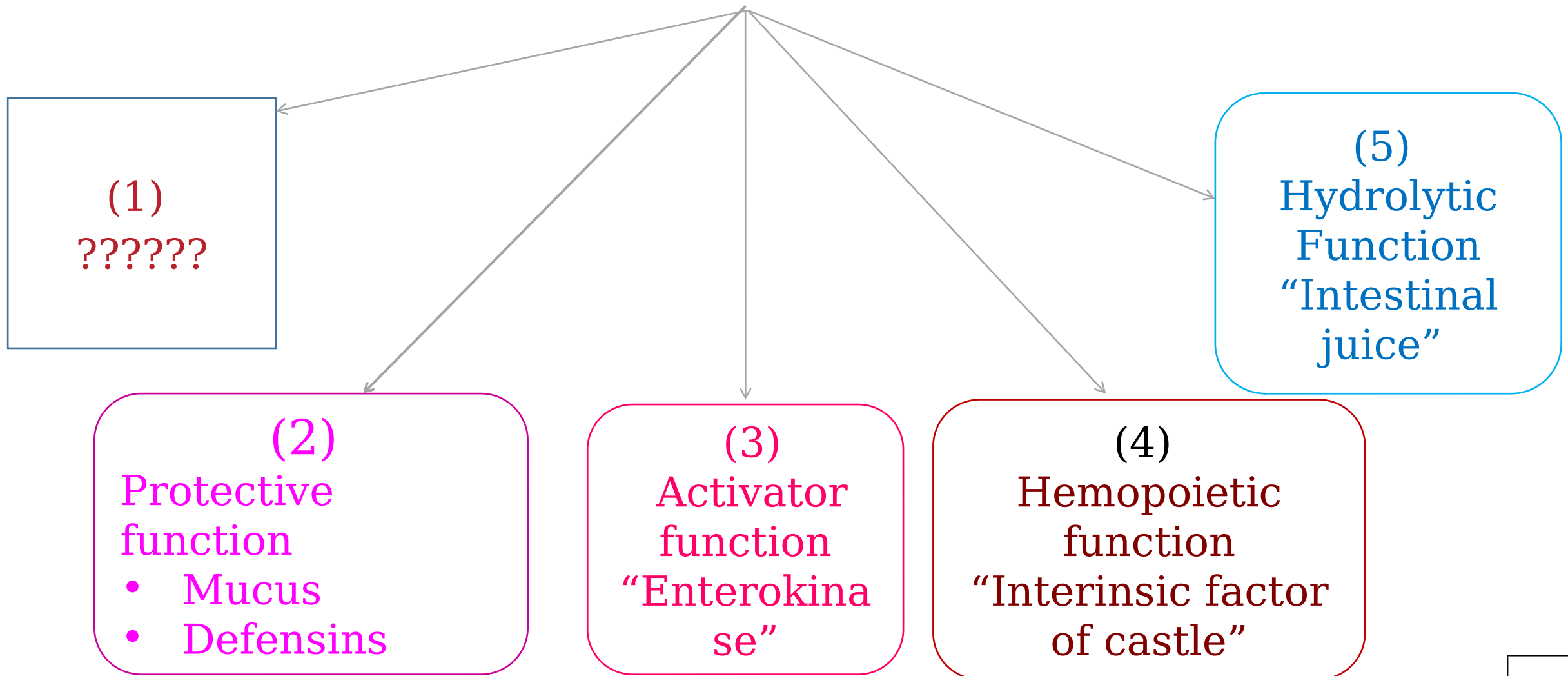
co-transporters”

Water soluble
vitamins faster
than fat soluble
vitamins

Absorption of other ??? in small intestine

????? Bile acids?????

Other functions of succus entericus



- Discuss the different functions of succus entericus

Large Intestine Functions



Absorptive function

- Absorption of various substances

Formation and storage of feces

- The unwanted substances after absorption

Excretory function

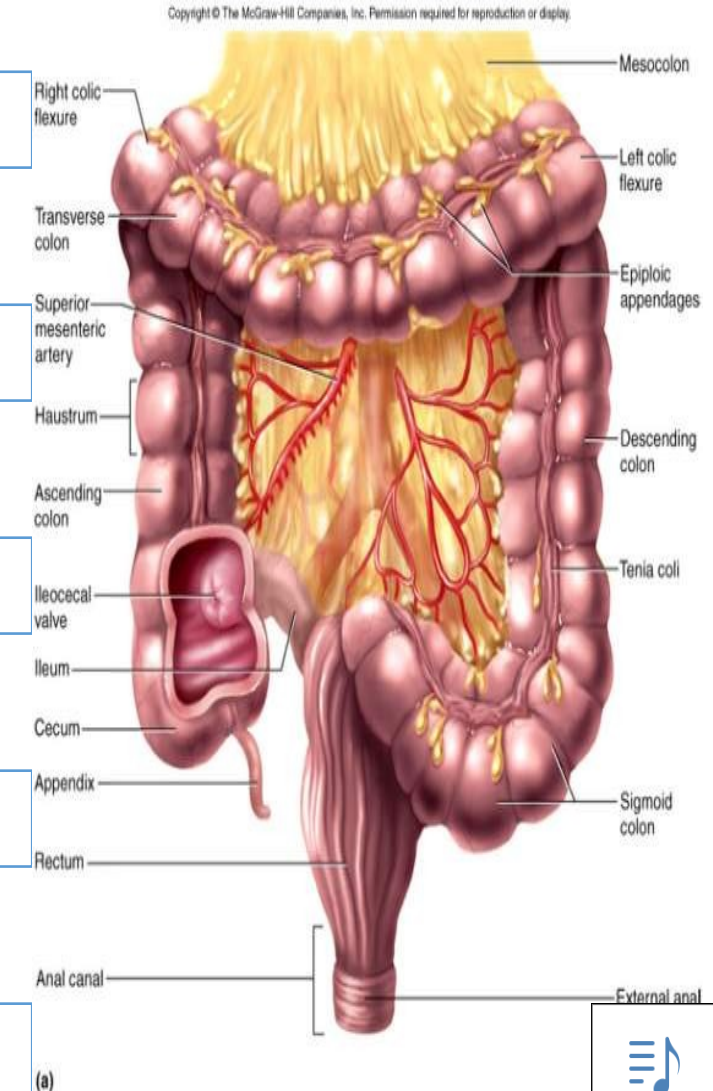
- Heavy metals
- Bile pigments

Secretory function

- Mucin and inorganic substances

Synthetic function

- Folic acid, several members of vit. B and vitamin K, short chain fatty acids,.....





Colonic mucosa

Absorbs

- 
- i. Water**
 - ii. Electrolytes**
 - iii. Organic substances like glucose**
 - iv. Alcohol**
 - v. Drugs like anesthetic agents, sedatives,..... and steroids**

Vitamins
produced by
bacteria



Large Intestine Secretions



Composition of large intestine Secretions

Water 99.5 %

Solids 0.5 %

Organic substances

Inorganic substances

1. Albumin
2. Globulin
3. Mucin
4. Urea
5. Debris of epithelial cells

1. Sodium
2. calcium
3. Potassium
4. Bicarbonate
5. Chloride
6. Phosphate
7. Sulfate

Properties

- The juice of large intestine is watery Alkaline fluid
- The pH of it is 8.0

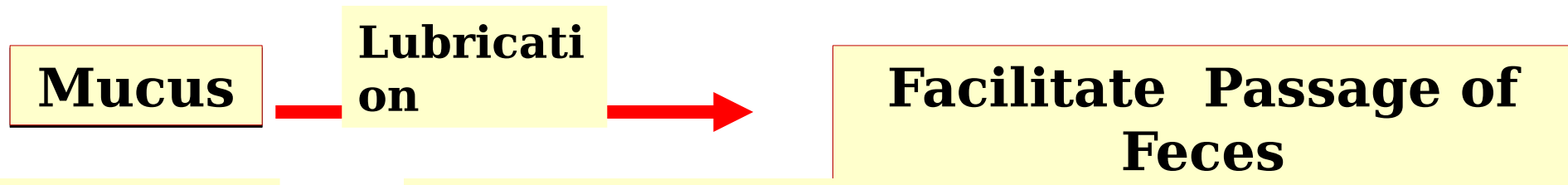
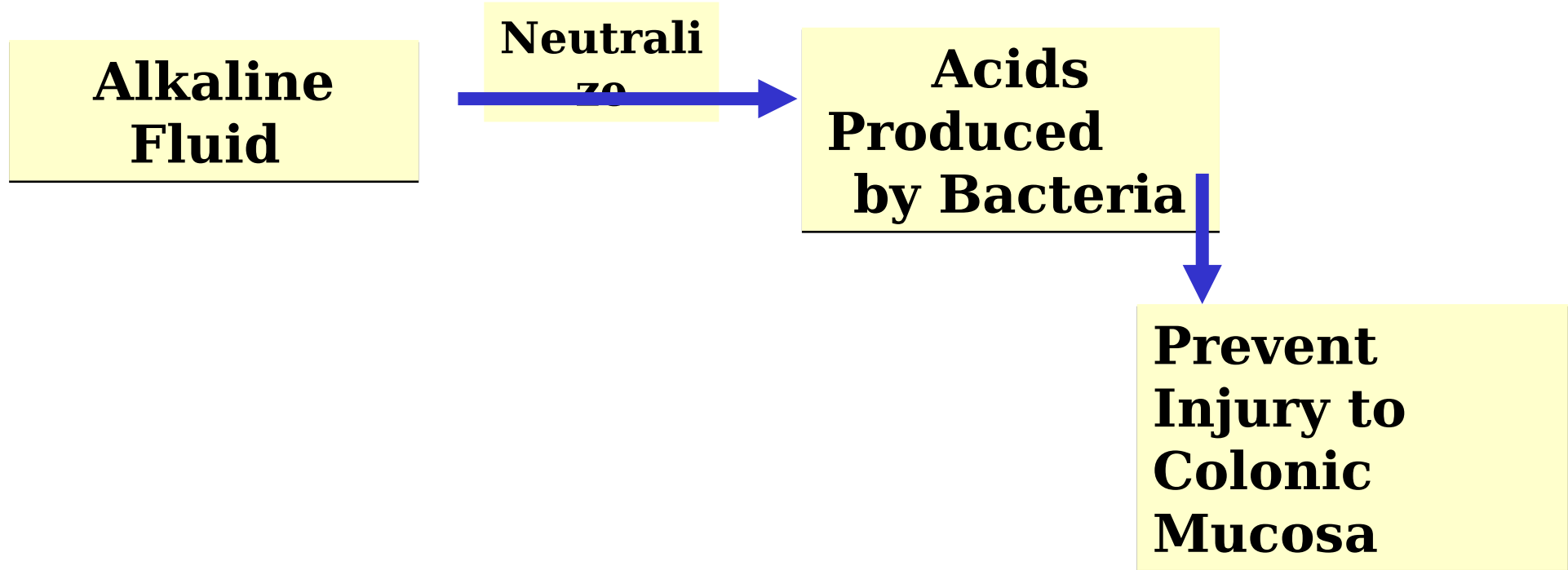
No Digestive Enzymes

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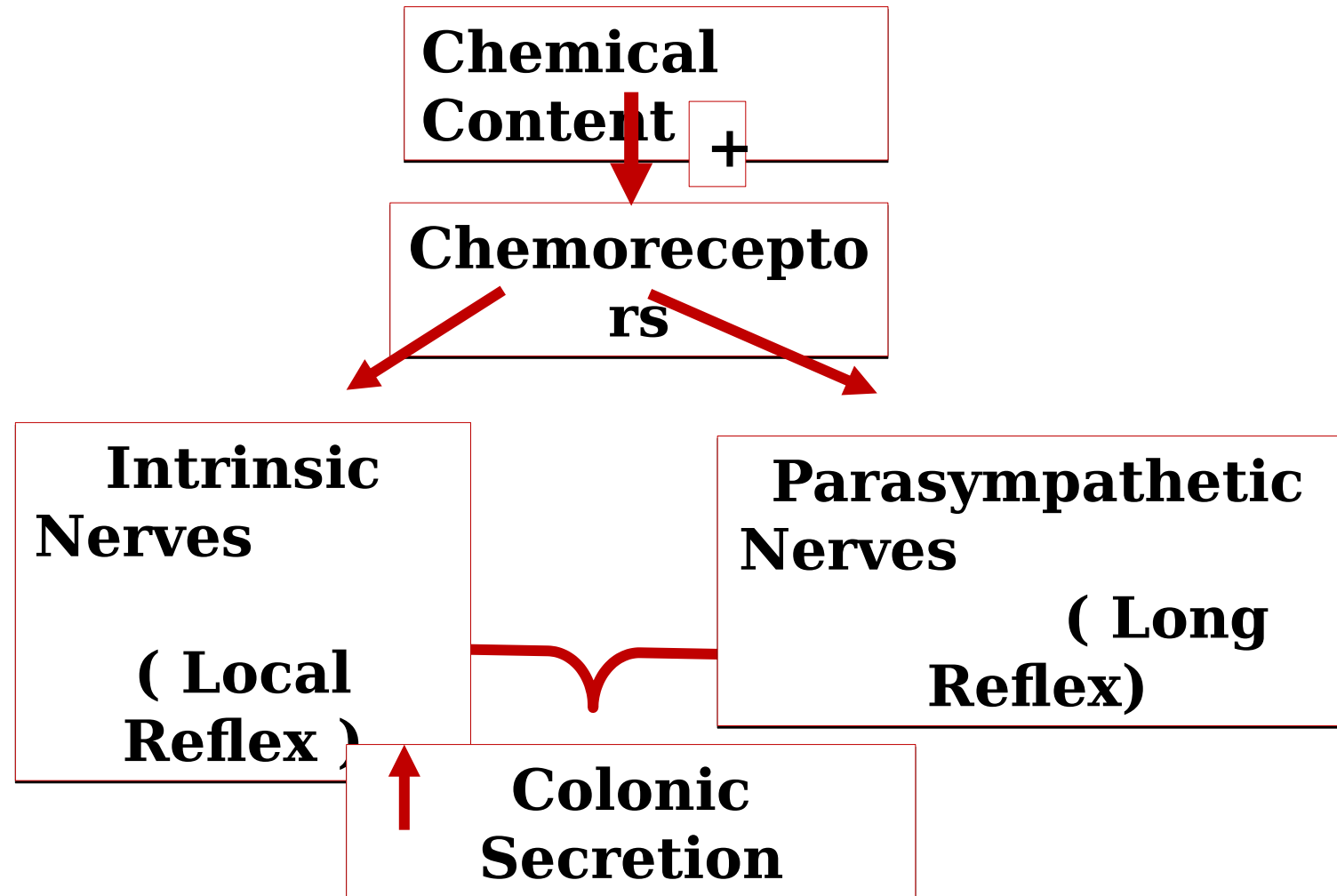
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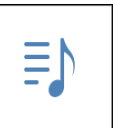
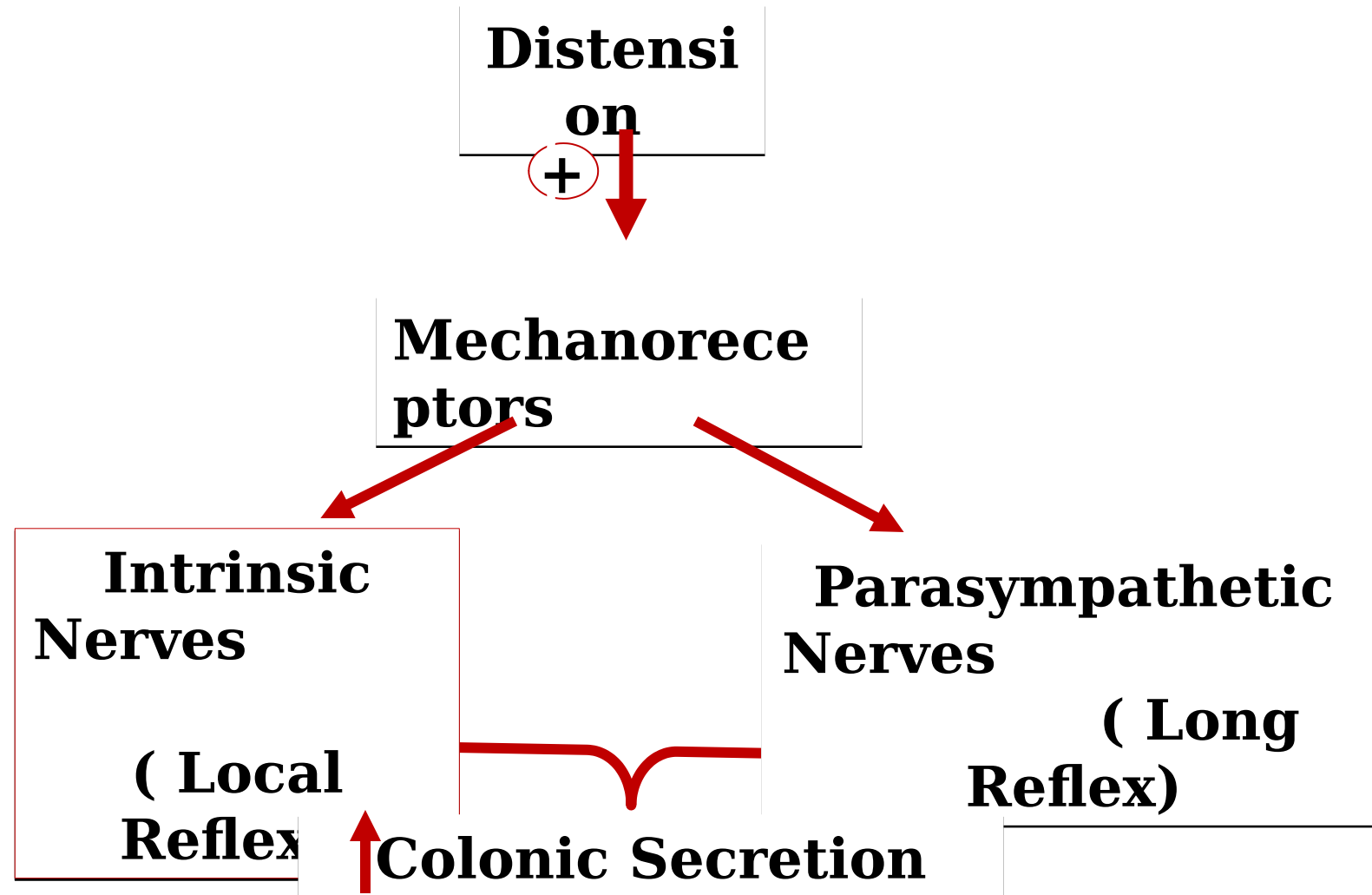
Function of Colonic Secretion



Control of Colonic Secretion



Control of Colonic Secretion



Lecture Quiz



Q1. Most digestion occurs in

- a) Stomach
- b) Small intestine
- c) Large intestine

Q2. Which of the following is correct about lipid absorption?

- a) Takes place mainly in the duodenum
- b) Depends on the formation of micelles
- c) Is sodium linked

Q3. Which of the following takes place in the small intestine?

- a) Protein digestion occurs only at the brush borders of the mucosal cells
- b) The mucosa secretes acidic succus entericus
- c) Bile salts are absorbed in the terminal ileum

Q4. The stimulant for trypsinogen is.....

- d) Fats in the duodenum
- e) Increased acidity of the duodenum
- f) Enteropeptidase



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Lecture Quiz



A 52 -year- female presents to the emergency room with hematemesis. After stabilizing her, if you are a gastroenterologist you can administer an analog of which of the following agents to inhibit gastric acid secretion?

- a) Acetylcholine
- b) Histamine
- c) Gastrin
- d) Somatostatin
- e) Pepsin



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SUGGESTED TEXTBOOKS



1. Ganong's "Review of Medical Physiology", 25th edition, Section V gastrointestinal physiology, Chapter 26, Page 464 to 473 & page 504
2. Guyton and Hall "Textbook of Medical Physiology", 13th edition, Chapter 64, Secretory Functions of the Alimentary Tract, from page 785 to 788
3. Sembulingam "Essentials of Medical Physiology", 4th edition, Chapter 14, Secretory Functions of the Alimentary Tract, from page 785 to 788

